

Technical Publication

**Code of Guidance for the Storage of Full and Empty LPG
Cylinders and Cartridges**

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The information in this document is intended to give guidance and believed to be accurate and represent good practice at the time of publication. It does not replace the need to consult other formal documents where further information may be required.

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Introduction

UKLPG Code of Practice No. 7 "Storage of Full and Empty LPG Cylinders and Cartridges" has been produced in full consultation with the Health and Safety Executive. It merges and updates the following earlier documents.

- HSE publication CS4, The Keeping of LPG in Cylinders and Similar Containers.
- HSE publication CS*, Small Scale Storage and Display of LPG at Retail Premises
- The previous edition of UKLPG (formerly LP Gas Association) Code of Practice No. 7.
- Revised in 2004 to incorporate Dangerous Substances and Explosive Atmosphere Regulations (DSEAR)

The information contained with the Guide is a summary of the information within the Code of practice for those involved in the handling and storage of LPG cylinders and cartridges.

Users are strongly recommended to obtain a copy of this Code of Practice from the UKLPG.

Liquefied Petroleum Gas (LPG) includes commercial butane, commercial propane and mixtures thereof as defined in British Standard BS:4250.

In general, the precautions to be taken in handling LPG are similar to those applying to petroleum spirit but in particular, all persons concerned with the handling of LPG should be familiar with the following properties.

- LPG is normally stored as a liquid under pressure.
- Leakage, especially of liquid, may release large volumes of flammable gases.
- A very small proportion of LPG released into air can give rise to an explosive mixture.
- LPG vapour is heavier than air and may flow along the ground or through drains and be ignited at a considerable distance from the source of leakage. In still air, any vapour will disperse slowly.
- LPG liquid, by its rapid vaporisation and consequent lowering of the temperature, can cause severe frost burns if it comes into contact with the skin.
- For general purposes, LPG is odourised before distribution so that its distinctive smell can give warning of a gas escape.

General Storage Information

- It is preferable that all LPG is stored in the open air but where this is not practicable, particularly for cartridges, the quantities stored within the buildings should be restricted to those shown in Table 2.
- Access to all storage places by unauthorised persons should be prevented and such places should be marked with notices prohibiting smoking and the use of naked flames.
- Refillable LPG cylinders are considered to be full whatever the state of their contents.
- LPG should not be stored in the vicinity of cylinders containing other gases or hazardous substances without specialist advice.
- The position chosen for storage should always be level and concreted, paved or compacted to provide a load-bearing surface. Outdoor storage areas should be slightly graded for drainage of surface water.
- LPG should **NEVER** be stored below ground level in cellars or basements.
- There should be no openings into buildings, cellars or pits within 2m of an LPG storage area or the separation distance given in Table 1, whichever is greater. If there is an unavoidable opening within 2m, the opening should be securely covered and fitted with a suitable water seal to prevent the entry of vapour.
- The storage area should be kept free from weeds, long grass and accumulations of readily combustible material at all times.
- Cylinder stacks and cylinder areas situated outdoors are unzoned provided they comply with the requirements contained within this leaflet and are now not classified as hazardous places under DSEAR whereas previously they were zone 2.

Open Air Storage

Cylinders of Calor Gas which are stored in the open air or on an open loading platform or slipped trailer, must be kept at a specified distance from boundaries, buildings and sources of ignition in accordance the minimum distances shown in Table 1. This table shows how the separation distances vary in accordance with the total amount of LPG stored.

In outdoor Calor Gas cylinder storage areas, designed, constructed and maintained in accordance with UKLPG Code of Practice No. 7, any LPG releases should be small and controlled. The probability of ignition of the releases is low provided that appropriate precautions are taken. These include: -

- Posting and observance of appropriate warning notices: -
 - LPG is stored in the area;
 - That the contents are highly flammable;
 - That smoking or other sources of ignition including mobile phones and similar electronic devices are prohibited;
 - What to do in case of fire

- Control of access and sources of ignition: -
 - The storage area should not be accessible to the general public or other unauthorised persons
 - Strict control should be exercised on the access of vehicles and mechanical handling equipment into the storage area. Only vehicles associated with transfer and handling operations should be allowed in storage areas.
 - Transport vehicles should have their engines and auxiliary electrical equipment (radio's etc) turned off when containers are being loaded or unloaded. Such vehicles should be removed when loading or unloading is completed.
 - Other vehicles under the occupiers control may be parked within the separation distance but should be no closer than 3 m to the nearest container.
 - Suitable barriers should be used to prevent unauthorised access and accidental damage where necessary.

Calor Gas cylinder storage areas complying with the above are not hazardous places in the sense of the Regulations and the "Ex" sign described in DSEAR need not be displayed.

Separation Distances

Separation distances are intended to protect the LPG cylinder stacks from the immediate radiation effects of fires involving other facilities as well as to minimise the risk of escaping LPG being ignited before it has dispersed or diluted. Separation distances should not be confused with hazardous places.

The storage area should be no closer than the minimum separation distance from the property boundary, any building or fixed sources of ignition. The separation distances for a given quantity of LPG are shown in Tables below. The separation distance adopted should be the larger of the two distances (e.g. storage of 12 000 kg in four 3 000 kg stacks requires a separation distance of 7 m (Table A), in two 6 000 kg stacks a separation distance of 8 m is required (Table B), storage in one stack of 2 000 kg and a trailer of 10 000 kg a separation distance of 10 m is required (Table B).) These distances should minimise the hazards from incidents at or near the store. Separation distances should only be reduced by the use of a fire wall or other appropriate physical barrier of fire resisting construction.

Table A: Minimum Separation Distances for Total LPG Storage

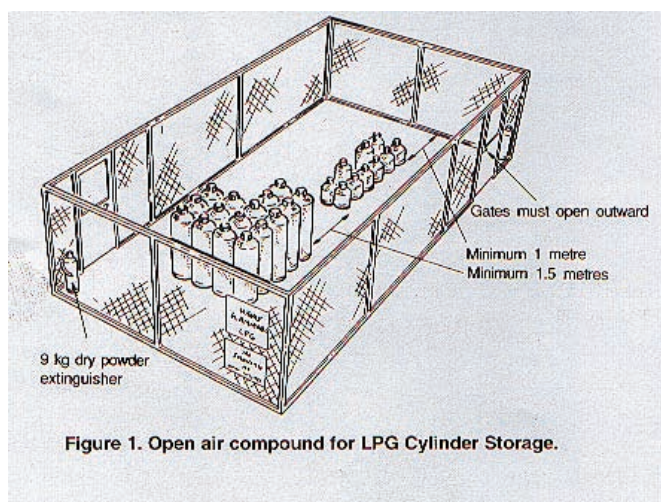
| Total Quantity of LPG Storage in Containers | | | | Minimum separation distance to boundary, building or fixed ignition source FROM NEAREST CONTAINER (where no fire wall is provided) | Minimum separation distance to boundary, building or fixed source FROM FIRE (a), (b) |
|--|---------|----|---------|---|---|
| <i>(1) Kilograms</i> | | | | <i>(2) Metres</i> | <i>(3) Metres</i> |
| From | 15 | To | 400 | 1 (c), (d) | Nil |
| Above | 400 | To | 1 000 | 3 | 1 |
| Above | 1 000 | To | 4 000 | 4 | 1 |
| Above | 4 000 | To | 6 000 | 5 | 1,5 |
| Above | 6 000 | To | 12 000 | 6 | 2 |
| Above | 12 000 | To | 20 000 | 7 | 2,5 |
| Above | 20 000 | To | 30 000 | 8 | 3 |
| Above | 30 000 | To | 50 000 | 9 | 3,5 |
| Above | 50 000 | To | 60 000 | 10 | 4 |
| Above | 60 000 | To | 100 000 | 11 | 4,5 |
| Above | 100 000 | To | 150 000 | 12 | 5 |
| Above | 150 000 | To | 250 000 | 15 | 6 |
| Above | 250 000 | | | 20 | 7 |

Table B: Minimum Separation Distances for Size of Largest Stack

| Size of Largest Stack | | Minimum separation distance to boundary, building or fixed ignition source FROM NEAREST CONTAINER (where no fire wall is provided) | Minimum separation distance to boundary, building or fixed ignition source FROM FIRE WALL where provided - (a), (b) |
|------------------------------|--------|---|--|
| <i>(1) Kilograms</i> | | <i>(2) Metres</i> | <i>(3) Metres</i> |
| Up to | 400 | 1 (c), (d) | Nil |
| to | 1 000 | 3 | 1 |
| Up to | 3 000 | 5 | 1,5 |
| Up to | 5 000 | 7 | 2,5 |
| Up to | 7 000 | 8 | 3 |
| Up to | 9 000 | 9 | 3,5 |
| Up to | 10 000 | 10 | 4 |
| Up to | 20 000 | 12 | 5 |
| Up to | 30 000 | 15 | 6 |

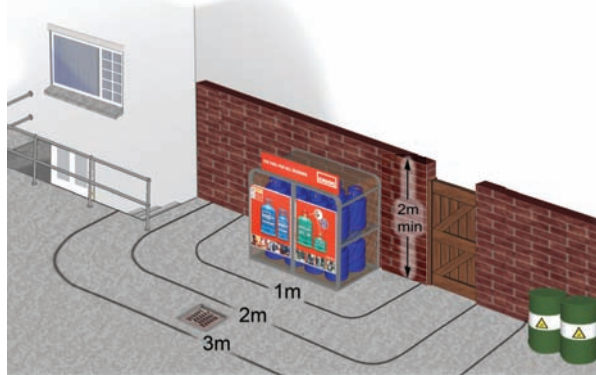
Notes

- a) The distance from the nearest container to a boundary, building, etc. should be not less than the distance given in Column (3) when measured around the fire wall.
- b) Minimum distance from the nearest container to a fire wall should be 1,5 m
- c) No separation distance is required for these quantities where boundary walls and buildings are of suitable construction
- d) There should be no opening into buildings, cellars or pits within 2m of an LPG cylinder storage area or the separation distance given in Tables A & B whichever is the greater. If a gully or drain is unavoidably within 2m, the opening should be securely covered or fitted with a suitable water seal to prevent the entry of vapour.

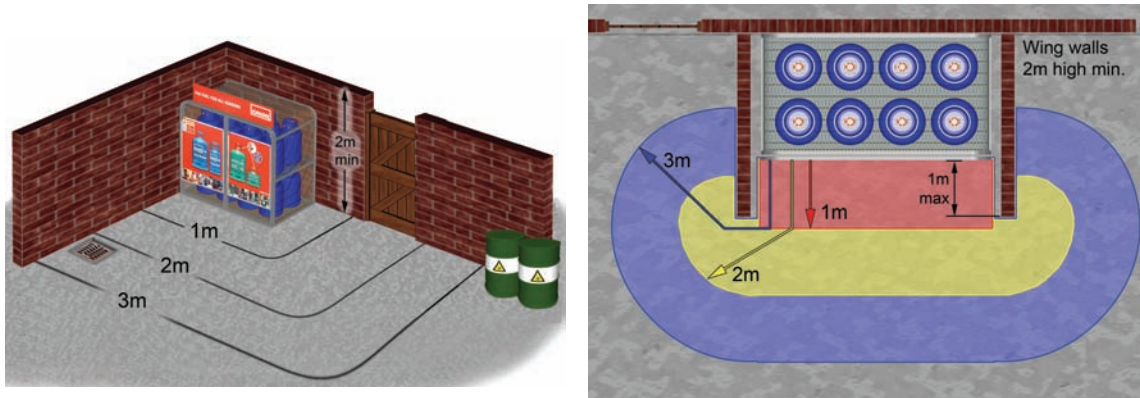


Notes

- Because the minimum separation distance is determined by considering either the total amount of LPG stored or the size of the maximum stack in the storage area, that which results in the greater distance is to be applied.
- If a radiation wall is to be provided, or the total storage or stock size is to be greater than those in the table, specialist advice should be obtained from the Technical Help Desk 01926 318497.
- The cylinder should not hinder or endanger the means of escape from the premises or adjoining premises.
- The outlet valve of every cylinder should be kept closed while the cylinder is in store or on display. Plastic caps or plugs must be fitted to cylinders even when they are regarded as empty.
- Cylinders must be stored or displayed with their valves uppermost. This ensures that if there is a leak from the valve area, vapour and not liquid will escape.
- At least one 9kg dry powder fire extinguisher **must be provided** in the vicinity of the cylinder storage and it should be serviced regularly.



Calor Gas cylinders may be stored in the angle between two walls, eg in the corner of a yard (See Fig. 4). It may also be convenient to store Calor Gas cylinders between two wing walls (See Fig. 5) provided that such wing walls do not exceed 2m in height.



Fire Walls

Where the minimum separation distances cannot be met, the use of fire walls permits the separation distances to be reduced to those in column (3) of Table A but specialist advice should be sought from the Calor Technical Help Desk 01926 318497.

Fire walls should be of solid construction from brick, concrete or solid masonry and should be capable of providing at least 30 minutes of fire resistance. If the firewalls form part of a residential premises the requirement is increased to at least 60 minutes of fire resistance.

The fire wall should be at least as high of the stack of cylinders but not less than 2m. Stores containing more than 400 kg should have no more than 2 fire walls and the remaining walls should be constructed so they do not impair the natural ventilation. If the store contains less than 400 kg it may consist of 3 fire walls.

Calor Gas cylinders should not be stacked against the fire wall except in a small store where 400 kg or less are kept. In other cases a space of at least 1 m should be provided between the stack of cylinders and the wall to allow access for inspection or the removal of any faulty cylinders.

Storage in Buildings

Where the storage of LPG in the open air is not practicable, Calor Gas cylinders may be stored within buildings, but the quantities shown in Tables 2 & 3 must not be exceeded.

Table 2

| Types of Building | Maximum quantity of LPG cylinders or cartridges | Remarks |
|---|---|--|
| Shops or Offices (a) With residential accommodation | 15 kg | Unless 60 minutes fire resisting separation is provided between the two occupancies with no direct access between, when up to 70 kg may be stored. |
| (b) Without residential accommodation | 70 kg | Not more than 5 cylinders or 20 if the maximum capacity is 3kg. No cylinder must exceed 20 kg capacity. |
| (c) Demonstration area (outside designated area) | 50 kg | Not more than 4 cylinders and 6 cartridges |

Table 3

| Specially designed single storey building | Max. LPG per compartment | Max. number of compartments | Total Max. in building | Remarks |
|---|--------------------------|-----------------------------|-------------------------|-------------------------------|
| With walls of at least 30 minutes fire resistance. (a) LPG Cylinders (b) LPG Cartridges | 5000 kg 50 000 kg | 5 5 | 25 000 kg 250 000 kg | Subject to certain conditions |
| Specially designed storage space within existing buildings. | | | | |
| With walls of at least 30 minutes fire resistance. (c) LPG Cylinders (d) LPG Cartridges | 1000 kg 5000 kg | 1 1 | 1000 kg 5000 kg | Subject to certain conditions |

Where LPG is used for heating or lighting it is preferable that Calor Gas cylinders are kept in the open air and the supply piped to the appliances. Where this is not practicable, the total quantity of LPG

used for heating / lighting and demonstration purposes and display may be increased to, but not exceed, 100 Kg in total.

NOTE: For details of design requirements for suitable buildings, specialist advice should be obtained.

Indoor Cylinder Storage

For indoor Calor Gas cylinder storage areas the situation is complex and a specific, documented risk assessment in accordance with DSEAR must be carried out both of the storage areas and of areas adjacent to ventilation openings. This may result in Zone 2 hazardous places being specified. In such places apparatus, which may act as a source of ignition (e.g. electrical equipment), must be tested, approved and certified in accordance with the Equipment and Protective Systems for Use in Potentially Explosive Atmospheres Regulations 1996. Within such stores:

- Fixed sources of ignition (i.e. pilot lights, naked flames) should be prohibited;
- Smoking should be prohibited;
- All other potential sources of ignition should be controlled;
- Only vehicles associated with the product transfer and handling operations should
- be permitted;
- Only equipment suitable for use in zoned areas and constructed to a recognized standard (e.g. BSEN 50014) should be installed;
- Older equipment built to earlier standards (e.g. BS 5501 series) remains acceptable provided it is correctly maintained and a risk assessment shows that it is still suitable.
- Electrical equipment should be suitable for the zoned area in which it is installed
- Any portable electrical equipment or generators used temporarily within hazardous places should be in accordance with the recommendations of BSEN 60079 and should meet the requirements of the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996 for the zone in which it is to be used or otherwise be covered by a permit to work scheme.
- Older equipment built to earlier standards (e.g. BS 5501 series) remains acceptable provided it is correctly maintained and a risk assessment shows that it is still suitable.

The selection, installation and maintenance of fixed electrical apparatus for use in hazardous places or within the separation distances should be in accordance with the recommendations of BSEN 60079. For LPG, equipment with a temperature rating of T2

is adequate. Higher T ratings imply lower maximum operating surface temperatures on equipment, and any equipment with a higher T rating will also be suitable.

Note: Electrical equipment to BSEN 60079 will not necessarily be weatherproof.

Degrees of protection against weather are indicated by an IP rating in accordance with BSEN 60529, for external use the minimum rating is IP 54.

Electrical work within hazardous places should only be carried out by suitably trained personnel who can prove competence in the type of work being undertaken.

Individual electricians should have successfully completed suitable training appropriate to the tasks to be undertaken and reflecting the Electricity at Work Regulations and the Dangerous Substances and Explosive Atmospheres Regulations.

(For many types of work this will mean a COMP 'Ex' or similar training course) and their training suitably recorded, e.g. an appropriately endorsed "Joint Industries Board" (JIB) card. A JIB card includes a summary of training on the back of the card.

The "Ex" sign described in DSEAR need not be displayed if suitable warning signs are in place to warn people of the flammable nature of any release from the tank or fittings.

Storage in Commercial and Industrial Premises

For further information on the storage and use of propane cylinders at and within commercial and industrial premises, refer to UKLPG Code of Practice No.24 Part 6 'Use of Propane in Cylinders at Commercial and Industrial premises'.

Rooftop Storage

Providing that the total quantity of stored does not exceed 400 kg and the following points are adhered to, Calor Gas cylinders may be stored in the open air on a roof.

- The storage area should be situated in accordance with Table 4. Any openings into chimneys or air intakes should be at least 1 m above the level of the tops of any stacked cylinders.
- Other material should not be stored on the section of roof for LPG storage.
- The area used for storage should be level, structurally adequate to carry the weight of the cylinders and constructed to provide at least 60 minutes fire resistance.
- The roof should be well ventilated and should not be enclosed on more than two sides by other higher parts of the buildings or adjacent buildings.

Table 4

| Feature | Horizontal separation distance from | |
|--|-------------------------------------|------------|
| | Cylinders | Cartridges |
| Boundaries, openings into buildings, edges of the roof, drains, vents and sources of ignition. | 3m | 1m |
| Mechanical ventilation system intakes, outlets from chimneys, flues etc. | 5m | 1m |

Storage of Empty Cylinders

For the purpose of defining separation distances, all Calor Gas cylinders are to be considered as full whatever the state of their contents.

Nominally empty cylinders should be segregated from full ones and an appropriate indication made so that they can be readily distinguished from each other.

Stacking Cylinders

The maximum size of any stack should not exceed 30,000 kg.

The gangway between unpalletised stack should not be less than 1.5m and between palletised stacks should not be less than 2.5m.

The maximum height of any unpalletised stack should not exceed 2.5m. The amount of LPG in any vertical column of a stack should not exceed that shown in table 5 and there should be no more than 7 pallets in any vertical column of any stack.

Table 5

| Amount of LPG in any cylinder (kg) | Amount of LPG in any vertical column | |
|---|---|-------------------|
| | Non Palletised | Palletised |
| Up to 6 | 30 | 35 |
| 6 – 15 | 45 | 75 |
| 15 – 20 | 50 | 80 |
| 20 – 55 | 55 | 110 |

Storage of Cylinders on Vehicles or Trailers

- No cylinder of Calor Gas shall be stored in an enclosed vehicle other than a cylinder which is specifically designed to keep fuel for the motive power of the vehicle. Such cylinders should not be included in storage quantities.
- Cylinders kept on a vehicle or a trailer should be treated as a single stack and the appropriate separation distance given by table 1 should be applied.
- For the carriage of cylinders in closed vans see UKLPG Code of Practice No. 27.

Electrical Equipment Area Classification

Wherever practical, electrical equipment should not be installed within a hazardous area.

All electrical apparatus for used in classified zones should have certification in accordance with BS 5345.

The electrical installation should conform to BS 7671 and BS 5345 where it is located in hazardous areas.

| Location | Extent of Classified Area | Area Classification |
|---|--|-----------------------------|
| Storage place of the type described in open air storage | <p>In the storage place up to a height of 1.5m above the top of the stack or beneath any roof over the storage place.</p> <p>Outside the storage area or space covered by any roof up to 1.5m above ground level and within the distance set out for a fixed source of ignition.</p> | <p>Zone 2</p> <p>Zone 2</p> |
| Keeping within a shop or office | Within 1.5m in all directions of an LPG cylinder | Zone 2 |
| Storage within a specially designed building | <p>Within the building</p> <p>Outside the building up to 1.5m above ground level and within the distances set out for a fixed source of ignition.</p> | <p>Zone 2</p> <p>Zone 2</p> |
| Storage within specially designed storage places within buildings | The entire storage space | Zone 2 |

Electrical installations within the Separation Distances

Unless a specific, documented, risk assessment has demonstrated the risk to be insignificant, only explosion protected electrical equipment (e.g. meeting the requirements of Equipment Group II, Category 3, "G" of the Equipment and Protective Systems Intended for Use in Potentially Explosive Atmospheres Regulations 1996) should be permanently installed within stacks or the separation distance given in Tables 1a and 1b and to a height of 15 m above the stack.

Older equipment built to one of the standards in the BS 5501 series remains acceptable provided it is correctly maintained.

Any portable electrical equipment used temporarily within separation distances should be disconnected and removed as soon as work is finished.

Handling Considerations

- Calor Gas cylinders or cartridges should be kept in a readily accessible place to facilitate quick removal in case of necessity.
- Whether LPG cylinders are full or 'empty' they should be kept with the valves uppermost, except where cylinders are designed to be used otherwise. This requirement does not apply to LPG cartridges which are not fitted with valves.
- Particular care should be exercised when handling cylinders and cartridges and they should not be dropped or allowed to come into violent contact with one another or any adjacent object.
- The outlet valve is required to have a protective cover, cap or plug, this must be kept in place whilst the cylinder is being handled or stored.
- Cylinders should not be used for any purpose other than their proper use.

Leak Detection

- Cylinders should be inspected regularly for leakage.
- Never attempt to find a leak by means of a naked flame.
- Leaks can be detected by :-
 - Sense of smell
 - The sound of escaping gas
 - By condensation or frosting round the leak
 - Leaks may be confirmed by brushing soapy water over the suspected leak source.
- The provision of automatic flammable gas detection equipment should be considered for enclosed storage locations.

Fire Precautions

It is recommended that the fire authority should be consulted in case of all storage in excess of 1000 kg regarding fire fighting equipment, water supplies, means of access for fire fighting appliances, protection of fire fighting personnel and arrangements generally to ensure an early call to the Fire Brigade in the event of a fire breaking out.

Fire Extinguishers

Fire extinguishers should be and should be selected installed and maintained to BS 5306 Part 3. Dry Powder fire extinguishers should have a rating of at least 223B and comply with BSEN 3

The dry powder extinguisher(s), should be located in easily visible positions near exits, at perimeter of the store and in safe positions on access routes between stacks.

| Quantity of LPG Stored | Minimum Number of Fire Extinguishers (9kg Dry Powder) |
|------------------------|--|
| < 400 Kg | 1 |
| ≥ 400 Kg | 2 + 1 per additional 10 000 kg or part thereof in excess of 5000 kg (e.g. 25 000 kg = 4) |

Water availability

- For stores between 400 kg and 25 000 kg LPG, an adequate and readily available supply of water should be provided.
- For stores 25 000 kg or more the water supply should be sufficient to supply a minimum of two water monitors with at least 1 150 litres per minute for 60 minutes.
- Connections for hoses from bulk water storage should be compatible with those used by the fire brigade.
- Hose reels should be in accordance with BS 5306 Part 1.

Further information may be obtained from UKLPG Code of Practice No. 3 "*Recommendations for Prevention or Control of Fire Involving LPG*)

Training

All personnel should be aware of the location of the fire appliances and should know how to handle them. Fire drills should be carried out periodically.

Emergency Procedure

Leaking Cylinder Without Fire

If a cylinder is found to be leaking and the leak cannot be stopped by closing the valve or inserting the bung or fitting the cap, nearby sources of ignition must be extinguished and the cylinder carefully removed to a well ventilated open space clear of drains and buildings and free from all sources of ignition. It should be left with the leak uppermost, marked as faulty and notices displayed prohibiting smoking and other naked lights.

IN NO CIRCUMSTANCES SHOULD AN ATTEMPT BE MADE TO DISMANTLE OR REPAIR DEFECTIVE CYLINDER VALVES BY UNQUALIFIED PERSONS.

In Case of Fire

- Dial 999 and inform the emergency services that LPG is present.
- Evacuate all persons from the danger area, except those required to deal with the emergency.
- Where a fire in nearby materials is threatening Calor Gas cylinders, they should be removed to a safe place, providing this can be done without exposing anybody to danger.

Subsequent Action

- Always approach any fire or gas leak from up wind if it is safe to do so and under such protection as is available. Due regard must be given to the possibility of jets of flame from pressure relief valves.
- Initially the application of dry powder extinguishers is recommended if it is likely that the leakage can be stopped by operating the cylinder's valve or speedy removal of the cylinder can be achieved.
- Cool with water all Calor Gas cylinders, which cannot be removed.

Bibliography

UKLPG Codes of Practice: -

No. 7 Storage of Full and Empty LPG Cylinders and Cartridges.

No. 3 Recommendations for Prevention and Control of Fires Involving LPG.

No. 24 Part 6 Use of Propane in Cylinders at Commercial and Industrial Premises.

The above codes may be obtained from UKLPG www.uklpg.org

Further Information

Further information may be obtained from the following Calor Gas Publications: -

- 104368 Cylinder Cage Instructions for Use
- 104500 Cylinder Storage Information Leaflet.

If you have any queries please contact the Calor Technical Help Desk 0845 602 1143